Bipolar Transurethral Resection of Prostate: Clinical and Urodynamic Evaluation

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OBJECTIVES To report our experience with the clinical effectiveness of endoscopic resection of the prostate using the bipolar Gyrus PlasmaKinetic System.

METHODS A total of 120 patients with lower urinary tract symptoms were observed from 2002 to 2005. Of these 120 patients, 90 developed benign prostatic hyperplasia and were considered to have obstruction, and 51 of these 90 were scheduled for prostate surgery. The patients were randomized 1:1, using envelopes, into two groups: bipolar transurethral resection of the prostate (TURP) using the Gyrus PlasmaKinetic System (PK group) and monopolar TURP (standard TURP group). All patients were evaluated at baseline and follow-up (12 months after treatment) by medical history, International Prostate Symptom Score, inclusive of the question on quality of life, and physical examination, including digital rectal examination, transrectal ultrasonography, and pressure flow study. Statistical analysis was applied on the change in International Prostate Symptom Score and urodynamic parameters comparing the endpoints with baseline and comparing the baseline and follow-up characteristics between the two groups.

RESULTS The mean resection time was 39.1 minutes and 31.7 minutes for the PK and standard TURP groups, respectively ($P = 0.437$). The mean postoperative hemoglobin reduction at 24 hours of follow-up was 1.25 g/dL, with a 2.1% hematocrit reduction, in the PK group and 1.81 g/dL, with a 3.2% hematocrit reduction, in the standard TURP group ($P = 0.716$). Improvements in flow rate, International Prostate Symptom Score, quality-of-life score, and bladder outlet obstruction grade were comparable between the two groups.

CONCLUSIONS Bipolar TURP using the bipolar Gyrus PlasmaKinetic System seems to be a safe and effective procedure that is potentially associated with fewer side effects and could result in this procedure being more attractive for high-risk patients or, as recently proposed, for training purposes. UROLOGY 71: 252–255, 2008. © 2008 Elsevier Inc.

An enlarged prostate gland is one of the most common diseases in older men and is due to a histopathologic condition called benign prostatic hyperplasia (BPH), which usually develops after the fourth decade of age. The clinical manifestations of BPH include the symptoms, signs, and sequelae of urinary obstruction (bladder outlet obstruction [BOO]) caused by the enlarged prostate gland. Most men older than 50 years of age have some lower urinary tract symptoms owing to an enlarged prostate gland and seek treatment to improve their quality of life.[1] Transurethral resection of the prostate (TURP) is still considered the reference standard for BPH and is a very common operation.[1] TURP involves the surgical removal of the prostate's inner portion by way of an endoscopic approach through the urethra, with no external skin incision. An electrified loop is used to resect the prostatic tissue and cauterize any bleeding vessels. TURP is not a completely safe procedure, and several surgical options have been evaluated to reduce the related complications. The advantage of conventional monopolar TURP is the extensive tissue removal within a short time and the well-defined landmarks. However, it is associated with a 15% to 18% morbidity rate. Dilution hyponatremia and the related TUR syndrome, glycine toxicity when glycine has been used, capsular damage, and massive blood loss are of concern. Depending on the surgeon's experience, TURP is associated with a 2.5% to 4.2% risk of blood transfusion, a 5.5% risk of clot retention, and a 2% to 3% risk of TUR syndrome resulting from an electrolytic imbalance.[2–4] Other complications that have been reported in more than 5% of patients include, in order of frequency, sexual dysfunction (ejaculation and erectile dysfunction), irritative voiding symptoms, bladder neck contracture and urethral stricture, blood transfusion, urinary tract infection, and hematuria.[5] To reduce the morbidity related to TURP, several alternative procedures have been

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developed. Recently, bipolar energy has been adopted for TURP. The use of normal saline solution (NaCl 0.9%) instead of hyponatremic glycine or mannitol solutions with bipolar TURP decreases the morbidity associated with fluid absorption and allows for longer resection times. Several bipolar systems have been proposed and evaluated for TURP or transurethral resection of bladder tumors, with encouraging results.[6,7] The aim of our study was to report our experience with the clinical effectiveness of endoscopic resection of the prostate using the bipolar Gyrus PlasmaKinetic System (Gyrus Medical, Maple Grove, Md).

MATERIAL AND METHODS

A total of 120 patients with lower urinary tract symptoms, who were observed from 2002 to 2005, completed the International Prostate Symptom Score (IPSS) and underwent digital rectal examination, prostate transrectal ultrasonography, and a full urodynamic investigation with a pressure-flow study. Of these 120 patients, 90 (75%) were considered to have obstruction according to the Schaefer nomogram (obstruction class 2 to 5) and 30 (25%) were unobstructed. Of these 90 obstructed patients with BPH, 51 were scheduled for prostate surgery and were the object of this study. Patients with neurologic illness, renal insufficiency, bladder stone, or urethral stricture or who taking finasteride were excluded. The 51 patients were randomized 1:1, using envelopes, into two groups: bipolar TURP (PK group) and monopolar TURP (standard TURP group).

All patients were evaluated at baseline and follow-up (12 months after treatment) by medical history, IPSS, inclusive of the question on quality of life, physical examination, including digital rectal examination, transrectal ultrasonography, and pressure-flow study. Transrectal ultrasonography was performed with a biplanar linear transrectal probe (Ansaldo, Milan, Italy) and the postvoid residual urine volume assessment was obtained with a suprapubic 3.5-MHz probe. The urodynamic equipment used was a multichannel system (Dantec, Medtronic). The investigations were performed using fluid-filled lines and an external transducer. An 8F transurethral dual-lumen catheter for bladder pressure measurement and bladder filling was used. An 8F rectal balloon catheter was used for abdominal pressure recording to obtain the value of the detrusor pressure. The midstream urinalysis with urinary sediment and culture were negative at the urodynamic evaluation, and all patients signed an appropriate informed consent form before the test. Before cystometry, the bladder was emptied through the lumen of the transurethral catheter. The transducers were balanced to the atmospheric pressure before starting the test. The bladder was then filled with sterile water at 20°C, with a filling speed of 50 mL/min. The maximal flow, detrusor pressure at maximal flow, and minimal urethral opening pressure were plotted on the 1993 version of the Schaefer nomogram to obtain the linear passive urethral resistance relation and the Schaefer obstruction class. All the procedures were performed using the well-described principles of endoscopic transurethral prostatic resection.[8]

Conventional monopolar TURP was performed with a Storz 26Ch continuous irrigation resectoscope and a Soring electrosurgical generator. Mannitol solution was used as irrigation fluid. Plasma kinetic electroresection of the prostate was performed using the Plasma Kinetic Tissue Management System (Gyrus Medical, Bucks, United Kingdom), with a bipolar electrosurgical device.[6,7] It consists of a generator with a 200-W capability, a radiofrequency range of 320 to 450 kHz, and a voltage range of 254 to 350 V, a PlasmaKinetic standard continuous irrigating resectoscope (27F outer sheath), and a TUR loop of 80/20 platinum/iridium alloy electrode), with the active and return electrode on the same axis and separated by a ceramic insolator.[6,7] The prostate was resected transurethrally using a 0.9% NaCl saline solution as irrigation fluid. All patients received regional anesthesia and 1 g of cefotaxime 1 hour preoperatively. At the end of the procedure, the bladder was irrigated to remove all the prostatic chips, which can cause catheter blockage after surgery. Next, a 22F irrigating catheter was inserted, and irrigation with physiologic saline solution was initiated in the operating room and continued until the patient was able to drink an adequate amount of fluid for auto irrigation. The catheter was removed once the urine was completely clear, and the patient had passed stool. A single experienced surgeon performed all the procedures. The resection time was recorded for both groups.

Table 1. Patient characteristics

Characteristic	TURP	PK TURP	*P* Value
Patients (n)	26	27	
Age (yr)	63 ± 5	65 ± 5	0.39
Prostate volume (cm^3)	48 ± 9	49 ± 11	0.54
IPSS	20 ± 4	21 ± 2	0.59
QOL score	3.6 ± 1	3 ± 1	0.43
Qmax (mL/s)	8.7 ± 2	7 ± 1	0.83
PVR volume (mL)	96 ± 97	99 ± 58	0.06
Schaefer obstruction class	3.6 ± 1	4 ± 0.7	0.54

TURP = transurethral resection of prostate; PK = Gyrus PlasmaKinetic System; IPSS = International Prostate Symptom Score; QOL = quality-of-life; Qmax = maximal urinary flow; PVR = postvoid residual (urine).
Data presented as mean ± standard deviation.

Statistical Analysis

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS, Chicago, Ill) software. The data distribution was normal, and the parametric Student *t* test and one-way analysis of variance test were used as appropriate for analysis The statistical analysis was applied to the change in the IPSS and urodynamic parameters comparing the endpoints with baseline and the baseline and follow-up characteristics between the two groups. Statistical significance was considered at $P < 0.05$ for all analyses. The data are presented as the mean ± standard deviation.

RESULTS

A total of 51 patients were enrolled and evaluated in this study. The baseline characteristics were comparable between the two groups (Table 1). The mean follow-up was 12 months. The mean resection time was 39.1 minutes (range 25 to 65) and 31.7 minutes (range 20 to 53) for the PK and standard TURP groups, respectively ($P = 0.437$). The mean postoperative hemoglobin reduction after 24 hours of follow-up was 1.25 g/dL (range 0.7 to 2.3), with a 2.1% hematocrit reduction, in the PK group

Table 2. Postoperative findings

Finding	TURP	PK TURP	*P* Value
Transfusions (n)	0	0	
TUR syndrome (n)	0	0	
Irrigation time (hr)	30.9 ± 4	22 ± 4	0.000
Mean catheterization time (hr)	31.9 ± 4	23 ± 4	0.000
Postoperative hospital stay (hr)	50.6 ± 3	48 ± 1	0.897

TUR = transurethral resection; other abbreviations as in Table 1. Data presented as mean ± standard deviation.

and 1.81 g/dL (range 0.9 to 3.5), with a 3.2% hematocrit reduction in the standard TURP group ($P = 0.716$). No significant changes in sodium levels were recorded: 141 ± 2 mEq/L to 140 ± 2 mEq/L in the standard group ($P = 0.46$) and 140 ± 1.5 mEq/L to 140.8 ± 1.8 mEq/L in the PK group ($P = 0.13$). The mean postoperative data are shown in Table 2. The catheter was removed about 1 hour after discontinuing bladder irrigation, which was routinely performed for at least 24 hours. The patients were discharged form the hospital at least 8 hours after catheter removal and after passing clear urine, but no patients were routinely discharged from the hospital after 6 PM. Delay clot retention (7 to 10 days after hospital discharge) was observed in 5 patients in the standard TURP group and 1 patient in the PK group. Acute urinary retention within 24 hours after catheter removal was observed in 1 patient in the PK group and was associated with a concomitant urinary tract infection. In both groups, 1 patient presented with bladder neck stricture approximately 4 months after the procedure, and both patients were treated with internal urethrotomy and reevaluated 8 months later. The clinical and urodynamic parameters evaluated 12 months after the procedures are listed in Table 3. The improvements in flow rates, IPSS, quality-of-life scores, and BOO grade were comparable between the two groups. No significant differences were found in the postoperative prostate volume between the two groups ($P = 0.87$).

COMMENT

In 2007, monopolar electrosurgical TURP is still considered the reference standard surgical treatment for relief of BOO related to BPH.[9,10] However, its morbidity and related mortality is still an important issue, and several attempts have been made to develop alternatively surgical techniques or to improve the TURP procedure with new resectoscopes or electrosurgical devices.[11] Complications related to TURP and reported in more than 5% of patients have included sexual dysfunction (7% to 13%), irritative voiding symptoms (9% to 23%), bladder neck contracture (5% to 8%), the need for blood transfusion owing to intraoperative or postoperative bleeding (5% to 11%), and urinary tract infection (5% to 9%).[11,12] Dilution and hyponatremia with the related TUR syndrome is a unique complication of TURP that occurs when the irrigant solution used during the operation is absorbed into the bloodstream and occurs in 2% to 3% of patients. Prostate size and resection time are perceived to be the two most important factors affecting the morbidity of monopolar TURP. Operator experience is essential to avoid complications.

Recently, bipolar energy has been adopted to perform TURP to reduce its morbidity.[13,14] The use of saline solution with bipolar TURP decreases the morbidity associated with fluid absorption and allows for longer resection times. Several bipolar systems have been developed, proposed, and evaluated for TURP. Several randomized studies have prospectively compared bipolar TURP versus standard TURP.[15–18] Bipolar resection, in particular the PlasmaKinetic Gyrus device, has been extensively investigated. No changes in serum sodium concentration were observed in patients who underwent bipolar TURP, independent of prostate size. Issa *et al.*[10] have reported a subgroup of 5 patients from an institutional cohort of 58 men treated with plasmakinetic bipolar TURP. This subgroup had large prostate resection weights (greater than 35 g) and significant comorbidity (American Society of Anesthesiologists risk category of 3 or more). Of this subgroup, the mean resected weight was 49.6 g (range 32 to 67) and was achieved during a mean operating time of 144 minutes (range 98 to 175), for a tissue removal rate of 0.35 g/min. In this group of patients, the mean serum sodium concentration decreased by only 1.6 mg/dL. In our series, no serum sodium concentration was observed, and no episodes of TUR syndrome were reported in either group. However, it is important to highlight that the mean prostate volume was less than 50 g in both groups, with a resection time of about 30 minutes in the standard TURP group. The use of bipolar TURP has also been associated with more rapid catheter removal and a shorter hospital stay but these data are controversial.[19,20] Seckiner *et al.*[15] in a prospective study compared standard TURP and PlasmaKinetic bipolar TURP in a 1:1 randomized study. No advantages in terms of the intraoperative and postoperative bleeding, resected tissue, catheterization time and irrigated volume, hospital stay, operation time, and late complications were observed for bipolar TURP. Other investigators have observed similar data.[11] In our experience, the irrigation time and mean catheterization time were significantly greater in the group of patients treated with standard TURP. However, the differences observed in terms of bladder irrigation time and catheterization time were not clinically significant and did not permit for early hospital discharge in the bipolar group. Our clinical organization also probably influenced these findings. In our experience, delayed clot retention was frequently observed in the standard TURP group compared with the PK group (19% versus 4%) and could be related to greater thermal damage and granulation tissue induced by monopolar current, such as was observed in animal models and

Table 3. Baseline and follow-up characteristics stratified by treatment

Variable	Standard TURP			PK TURP		
	Baseline	12 mo	*P* Value	Baseline	12 mo	*P* Value
IPSS	20 84	6.7 ± 4	0.000	21 ± 2	7 ± 1.7	0.000
QOL score	3.6 ± 1	1 ± 1	0.000	3 ± 1	1 ± 1	0.000
Prostate volume (cm^3)	48 ± 9	31 ± 9	0.000	49 ± 11	29 ± 8	0.000
Qmax (mL/s)	8.7 ± 2	23.2 ± 9	0.000	7 ± 1	24.2 ± 5	0.000
PVR volume (mL)	96 ± 97	27 ± 50	0.004	99 ± 58	20 ± 35	0.000
Schaefer obstruction class	3.6 ± 1	1.2 ± 0.6	0.000	4 ± 0.7	1.1 ± 0.6	0.000

Abbreviations as in Table 1.
Data presented as mean ± standard deviation.

suggested by other investigators.[19] However, larger studies are needed to better evaluate this point. Several reports have also demonstrated that bipolar TURP is as effective as TURP in relieving lower urinary tract symptoms in improving the IPSS and urinary flow after at least 12 months of follow-up.[19] However, no data are available on the effect of bipolar TURP in terms of urodynamically proven relief of BOO. Pressure-flow studies are considered the reference standard test to establish the presence of BOO. The pressure-flow study is considered an optional test in the evaluation of men with lower urinary tract symptoms due to BPH but is considered mandatory in clinical studies evaluating treatment modalities. As previously reported, we observed a significant reduction in terms of the IPSS and quality-of-life score with a concomitant improvement in urinary flow rates. We first showed that bipolar TURP can reduce or relieve BOO. A 66% rate of complete relief of BOO (Schaefer obstruction class 0 or 1) was observed in the group of patients treated with bipolar TURP after 12 months of follow-up and is comparable to the 64% rate observed in the standard TURP group. Bipolar TURP seems to be a safe and effective procedure that is potentially associated with fewer side effects that could lead to this procedure being more attractive for high-risk patients or, as recently proposed, for training purposes. Cost analysis evaluation and additional larger comparative studies with longer follow-up are needed to consider bipolar TURP as the new reference standard for BOO related to BPH.

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